

Thermocouple Extension & Compensation Alloys

Wire • Strip • Ribbon

JLC produces a wide range of alloys that are used to manufacture thermocouples, extension and compensating wires/cables. Thermocouples are formed by joining two dissimilar alloys that will produce a thermal EMF when the junctions are at different temperatures. Different grades of thermocouple alloys are used depending upon the temperature being measured.

Thermocouples are connected to the temperature indicating instruments by using the leads made of same material. These leads which have the same EMF output as the thermocouple are called Extension Leads. Use of extension leads avoids 'lead junction error'. However, for economic reasons, cheaper alloys having similar EMF output over a limited temperature range (generally 200 °C) are often used. These leads are called Compensating Leads.

JLC offers a full range of materials for Extension/Compensating leads. The different grades of these materials and the EMF tolerance for these grades over a required temperature range are shown in this data sheet.

Forms of Supply

Cold Drawn, Annealed.

Oxidized wire surface is also available for applications where corrosive atmosphere is present.

Specifications

JLC range of thermocouple alloys meets the specification of **ASTM E 230** and **ANSI MC 96.1**.

JLC can also manufacture thermocouple alloys to conform to any of the following specifications: IS, IEC, DIN, BS, NF, UNI, ENI, JIS, ENEL, or GOST.

Special tolerances and properties can be made available upon customer request.

Thermocouple	Extension or Compensation Alloy	Composition	American Specification (ANSI MC 96.1)			
			EMF	At Temp	Tolerance	
			mV	°C	Standard	Special
K	KPX-KNX (KX)	KPX (NiCr)	4.095	100.0	± 2.2°C 0°-200°C	-
		KNX (NiAl)	8.137	200.0		
K	Cu-CuNi44 KCB (VX)*	Cu	4.095	100.0	± 2.2°C 0°-100°C	-
		CuNi44	-	-		
K	Fe-CuNi43 (W) KCA*	Fe	4.095	100.0	± 2.5°C 0°-150°C	-
		CuNi43Mn2	8.137	200.0		
E	EPX-ENX (EX)	EPX (NiCr)	6.317	100.0	± 1.7°C 0°-200°C	-
		ENX (CuNi44)	13.419	200.0		
T	TPX-TNX (TX)	TPX (Cu)	-	-	± 1°C 0°-100°C	± 0.5°C 0°-100°C
		TNX (CuNi44)	4.277	100.0		
J	JPX-JNX (JX)	JPX (Fe)	5.268	100.0	± 2.2°C 0°-200°C	± 1°C 0°-100°C
		JNX (CuNi44)	10.777	200.0		
S / R	Cu-CuNi3 (SX) (RX)	Cu	0.645	100.0	± 0.057 mV From 0°-200°C	-
		CuNi3	1.440	200.0		
N	NPX/ NNX (NX)	NPX (NiCr)	2.774	100.0	± 2.2°C 0°-200°C	-
		NNX (NiSi)	5.912	200.0		

*Type VX, KCA, KCB are not included in ANSI

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Standard & Special grades

The EMF tolerance of standard grade of alloys is according to the table presented on the previous page. JLC's special grades offer closer tolerances ($\frac{1}{2}$ and $\frac{1}{4}$ of standard grades) for applications where higher accuracy is needed.

Nominal Physical, Electrical & Mechanical Properties (at room temperature for annealed wire)						
Alloy	Density g/cm ³	Electrical Resistivity at 20°C $\mu\Omega$ -cm	Temp Coeff of Resistance $\times 10^{-6}/^{\circ}\text{C}$		Thermal Linear Expansion Coeff. b/w 20-95°C $10^{-6}/\text{K}$	Thermal Conductivity W/m K
			Value	Temp range		
KPX	8.72	70.6	300	20-100 °C	17.0	19.2
KNX	8.60	29.2	1900	20-100 °C	17.0	29.7
Cu Ni44	8.90	49.0	60	20-100 °C	14.0	21.4
Cu Ni43	8.90	52.0	100	20-100 °C	15.0	21.0
SX / RX	8.91	12.0	1500	20-100 °C	16.0	-
Fe	7.86	13-14	5000	20-100 °C	11.7	66.2
NPX	8.53	100.0	90	20-100 °C	17.0	13.0
NNX	8.58	36.5	680	20-100 °C	17.0	27.0

Calibration

JLC thermocouple grades are calibrated over the temperature range according to international specifications. All JLC grades are individually calibrated versus **NBS Pt 67**. Each coil/spool is tested for EMF and value of deviation from the standard EMF at different temperatures is shown on the labels attached to each coil/spool. All JLC thermocouple materials are made confirming to EMF/temperature requirements for thermocouples as per **NBS monograph 125**. Alternatively, calibration is also performed as per **ASTM E220** comparison technique.

Size Range

JLC thermocouple materials are available in different sizes (mm/AWG/SWG) or resistance based upon customer's requirement.

Form	Dia (mm)	AWG
Wire	0.142-8.255	0-35

Strips and ribbons are also available in various sizes upon request

Final Inspection & Testing

Each spool/coil of JLC thermocouple, extension and compensating alloy is calibrated according to specifications given above. JLC thermocouple alloys are fully tested for homogeneity of chemical composition, physical, and thermoelectric properties. This includes the testing of electrical resistivity (loop resistance), which is an important property of thermocouple alloys.